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Introduction

This Phase I Accreditation Support Package (ASP I) is designed to provide a potential user with a characterization of the current state of ALARM version 3.1 with respect to criteria related to its general acceptability for use. The information collected in this phase should characterize the model well enough to provide an initial determination of its suitability for a particular application. It should also provide confidence that the model is well enough managed and supported to yield consistent results across its spectrum of users and applications. The information provided to characterize the subject model consists of the following elements:

a. A description of the configuration management (CM) baseline for the model, including version history, current version status, model development policy (including beta site provisions), documentation availability, and a summary of configuration management policies, procedures, guidelines and support functions in place for the model;

b. A summary of implicit and explicit assumptions and limitations inherent in the model because of its design and/or coding assumptions or structure, as well as any implied constraints to the use of the model that are a consequence of these assumptions or structures. A listing of known errors or anomalies found as a result of prior V&V efforts is also included;

c. A review of the model's development, verification and validation (V&V) and usage histories, as well as a summary of prior accreditations;

d. A review of the status of model documentation and its conformity to accepted software documentation standards, as well a review of documentation with respect to verification requirements; and

e. A summary of overall software quality as characterized by conformance to accepted design and coding practices.

ASP I provides the details of these information elements in a single document. The degree to which each information element is complete and current provides a general indication of whether the model is suitable for further consideration for use in a particular application.

Configuration Management Baseline

ALARM is an established model, originally implemented in 1977 by CALSPAN for what has become Wright Laboratory's Electronic Combat Simulation Research Laboratory (ECSRL) at Wright-Patterson AFB, OH. The model is distributed through the Survivability/Vulnerability Information Analysis Center (SURVIAC) and maintained by the Joint Technical Coordinating Group for Aircraft Survivability (JTCG/AS).

There are documented CM processes in effect for ALARM. The ECSRL Software Configuration Management Plan [7] documents specific procedures to be followed in processing, approving, and implementing changes to the baseline. CM is accomplished by the Model Manager (MM) and Configuration Control Board (CCB) through an orderly process of establishing baselines, approving changes to those baselines, and managing incorporation of approved changes. The ALARM point of contact at SURVIAC is responsible for distribution to authorized users. User organizations must sign a Beta Site Agreement with the ECSRL before receiving the code. This agreement allows users to modify the code to meet their own needs, but requires them to report all anomalies and changes to the ALARM CCB. Membership of the CCB consists of Air Force managers from the ECSRL, the MM, and developer representatives.

The current baseline version of ALARM is 3.1, which was released in June 1995. It is comprised of two software components: the model itself, and a group of eight utility support programs. ECSRL maintains the documentation, which is updated and released with each new version. The documentation set consists of a Software User's Manual [4], a Software Programmer's Manual [5], and a Software Analyst's Manual [6] (which is called an Operational Concept Document). Sample scenario files are included with each new release of the model. These demonstrate overall model functionality and provide a means of testing the user installation.

User support functions are in place for the model and include an organized users group that meets annually and a help line maintained by SURVIAC. Potential, or new users of ALARM will find a well documented and supported baseline version that can be applied to their analysis requirements.

Assumptions, Limitations, and Errors

Assumptions, limitations, and errors for version 3.0 are described in Section 3 of this ASP. These are being revised for the current version and will be distributed with the next update to this volume of documentation. Numbers of model deficiency reports (MDRs) have declined from previous versions while most design-related assumptions and functional limitations remain applicable to the current version.

V&V Status and Usage History

ALARM has been used by a number of DoD agencies and contractors for a variety of analytical applications since its original release. A User Group Point of Contact (POCs) Listing provided in Appendix B includes entries from approximately 120 organizations. Those seeking information to support accreditation of ALARM could be encouraged by the fact that this large and diverse user group places some degree of confidence in model results.

In spite of its extensive use over the years, there have been very few ALARM-related V&V efforts, and even fewer have produced documentation of their results. The table below summarizes the most prominent of those efforts. Note that many of the projects would not be classified as V&V efforts. Rather, they are studies that involved comparison of ALARM results with field test data and/or output from other models. Because of these comparisons with test data, some of the studies are categorized as validation efforts.

Table 1 Summary of V&V Status of Usage History of ALARM

Sponsoring Organization	Project Description
SMART Project	Sponsored V&V of ALARM92, 3.0, and 3.1. ASPs II and III contain detailed results of this effort. Comparisons with multipath measurements were mixed, while those with measured clutter spectra and distributions were good. No major model problems were fournd, but a number of errorswere uncovered and reported. Most critical functions were verified.
AFOTEC/ST	Validation activity has included several studies using ALARM 88, ALARM 91, and ALARM 3.0. All results are classified and are not readily available to other users.
AFOTEC/ST	In 1992, Dr. Dave Fisher of PRC, Inc., evaluated the version of ALARM91 (ALARM91m) modified for inclusion in the modeling system ACES/Phoenix (A/P). Within A/P, ALARM can be run in either “native mode” or in an integrated mode, employing the A/P triangular terrain, environmental zones, flight path generator, composite signal generator, generic radar clutter estimator (GRACE), and clutter map generator. Dr. Fisher focused on those algorithms which impact low observable studies, namely, clutter generation, clutter rejection, propagation factors, and noise. The evaluation was not considered a validation, but many conclusions were aimed at the effects that the algorithms may have on validation efforts.

Table 1 Summary of V&V Status of Usage History of ALARM

MIT, Lincoln Laboratory	Over a period of years, MIT's Lincoln Laboratory (LL) has compared ALARM model results with those from their proprietary in-house radar model, TRAJ. LL has performed its tests using ALARM 88, ALARM 91 and ALARM 3.0. This effort has had special importance because of the introduction of LL's copyrighted Spherical Earth/Knife Edge (SEKE) diffraction and multipath propagation algorithms into ALARM 91.
Joint project between the Canadian Defence Research Establishment Valcartier (DREV) and the US Army Materiel Systems Analysis Activity (AMSAA)	In September 1992, a joint project between DREV and AMSAA concentrated on the modeling of two factors affecting the performance of radar seeking missiles: ground clutter returns and radar propagation. The study used ALARM91 and IMARS (a suite of radar seeking surface-to-air missile simulations). It concluded that effects of terrain on propagation tend to affect target detectability more than clutter, and hence that engagement models which do not model terrain may yield unrepresentative results.
544th SIW	Several studies were conducted using different versions of ALARM, and included: (1) calibrating the initial antenna elevation angle, useful for improving the accuracy of model results; (2) comparison testing of ALARM88 and ALARM91, which showed no significant differences in model results; (3) independent testing of ALARM91, which revealed a factor of two error in noise predictions; and (4) comparison of ALARM90 and ALARM91 results with output from the TRAMS model and field test data, resulting in identification of MTI, antenna, clutter, and SEKE errors.
SAIC/WPAFB	Studies using ALARM 86, 88, 90, 91, and other versions were conducted. Model results were compared with those from the TRAMS model and with field test data, revealing some algorithm errors.
CD/NSWC	ALARM91 results were compared with the EREPS (Engineer's Refractive Effects Prediction System) model at NAVOCENSYSCEN; the results were nearly identical.
Loral Electronic Systems	Several studies were performed, using ALARM versions 81, 86, 88, 90, and 91. One such study validated the detection range for ALARM 81, against a cruise missile. The actual detection range vs. model prediction was within 0.4%. In other studies, ALARM results were compared with output from other models and with field test data; some errors were found.
ASC/XRE	Studies using ALARM versions 86, 88, 90 and a Navy version were conducted. ALARM results were compared with field test data (SECRET and TS) and output from other models. Numerous problems or errors were found.
Center for Naval Analyses	In 1988-89, validation work was performed using range data from two separate tests. ALARM was assessed to be an accurate predictor of the detection of the EA-6B at low altitudes.

Documentation Assessment

Minimum documentation requirements to support model verification were proposed in a Software Verification Requirements Study Report [9] commissioned by the SMART Project in 1992. Those requirements are summarized inSection 5 of this document along with an independent assessment of how well each ALARM document conforms with the proposed standards. The minimal model documentation set required for model verification consists of a Software Design Document (SDD), a Software User's Manual (SUM), a Software Programmer's Manual (SPM), and a Software Analyst's Manual (SAM). ALARM documentation includes a SUM [4], a SPM [5], and a SAM [6]. These documents are maintained by the ALARM MM and the software developer and reflect the current set for the baseline version. Documentation quality was assessed to be very good, but incomplete because a SDD does not exist. ALARM, like other so-called "legacy models," was not developed from formal design specifications, however, detailed design documentation is being developed and included in the Conceptual Model

Specification (CMS) sections of ASP-II. Results of the ALARM 3.1 documentation assessment are summarized in Table 2.

Table 2 Documentation Assessment Summary

Characteristic	SUM	SPM	SAM	SDD
Publication Date	**June 95**	**June 95**	**June 95**	**Sep 95**
Applicability	**ALARM 3.1**	**ALARM 3.1**	**ALARM 3.1**	**ALARM 3.0 & 3.1**
Completeness	**Adequate (Complete except for error messages, assumptions, limitations, and descriptions of output files)**	**Adequate (Complete except for variable and common block descriptions, detailed module descriptions, and error diagnostics)**	**Adequate (Complete except for assumptions, limitations, and detailed descriptions of algorithms)**	**Incomplete (Partially addressed by ASP-II CMS Sections being developed for SMART Project)**
Compliance	**Complies (Except for some minor modifications)**	**Complies (Except for some minor modifications)**	**Complies (Except for some minor modifications)**	**(Detailed FE design specs in progress)**

Software Quality Assessment

ALARM source code was evaluated in 1992 [11] for: 1) adherence to good programming practices and conventions, 2) computational efficiency, and modularity, as well as 3) algorithm development and memory utilization. The ALARM code was found to be well-structured, with extensive internal comments, and very modular. The source code was examined manually and analyzed using automated tools and its quality was assessed to be good. This assessment has not been updated for ALARM 3.1, but it is unlikely that quality has declined significantly, given that the programming practices that produced this evaluation are probably still in effect. That is, the model developer and programmers responsible for ALARM have not changed since then.